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Secondary Document

Sampling and Analysis Plan for Rubble Areas at the Paducah Gaseous Diffusion Plant Paducah, Kentucky

Sampling and Analysis Plan for the Characterization of PGDP Rubble Areas

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Sampling and Analysis Plan for Rubble Areas at the Paducah Gaseous Diffusion Plant Paducah, Kentucky

Sampling and Analysis Plan for the Characterization of PDGP Rubble Areas

Date Issued—September 2008

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
PADUCAH REMEDIATION SERVICES, LLC
managing the
Environmental Remediation Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-06EW05001

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ACRONYMS

AOC	area of concern
BWMA	Ballard Wildlife Management Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRDL	contract required detection limit
DOE	U.S. Department of Energy
DOE-CAP	DOE Consolidated Audit Program
DQA	data quality assessment
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ES&H	environment, safety, and health
FFA	Federal Facility Agreement
FSP	field sampling plan
FTL	field team leader
GFAA	Graphite Furnace Atomic Absorption
GPS	global positioning system
HDPE	high density polyethylene
HSO	health and safety officer
IDW	investigation-derived waste
KDEP	Kentucky Department for Environmental Protection
LM	laboratory manager
MDA	minimum detectable activity
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
OREIS	Oak Ridge Environmental Information System
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurement System
PGDP	Paducah Gaseous Diffusion Plant
PM	project manager
PPE	personal protective equipment
PPPO	Portsmouth/Paducah Project Office
PRS	Paducah Remediation Services, LLC
PQO	project quality assurance officer
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QL	quantitation limit
RCRA	Resource Conservation and Recovery Act
RCT	radiation control technician
RFI	RCRA Facility Investigation
RI	remedial investigation
SAP	sampling and analysis plan
SER	site evaluation report
SMO	sample management office
SOP	Standard Operating Procedure
SOW	statement of work
SRM	standard reference material
TCLP	toxicity characteristic leaching procedure
TVA	Tennessee Valley Authority

UCL	upper confidence limit
WAG	waste area group
WKWMA	West Kentucky Wildlife Management Area
WMP	waste management plan
XRF	X-ray fluorescence

1. INTRODUCTION

This sampling and analysis plan (SAP) details the sampling, analysis, and quality assurance/quality control (QA/QC) procedures to be used during the evaluation of rubble areas found outside the Paducah Gaseous Diffusion Plant (PGDP) industrialized area, as identified in the letter from U.S. Department of Energy (DOE) to the Kentucky Department for Environmental Protection (KDEP) and the U.S. Environmental Protection Agency (EPA) Region 4, dated February 16, 2007, regarding Notification of Soil and Rubble Areas. Appendix A describes the QA/QC elements.

In total, 29 rubble areas were identified in the Notification of Soil and Rubble Areas (Figure 1) as follows:

- Twelve rubble areas have been identified on DOE Reservation property, four of which are located on property licensed to the West Kentucky Wildlife Management Area (WKWMA);

- One has been identified on private lands managed by the Tennessee Valley Authority (TVA);

- Six rubble areas have been identified on WKWMA property; and

- Ten rubble areas have been identified in Ballard Wildlife Management Area (BWMA).

The origin of 28 of the 29 newly identified rubble areas is unknown.[1] The origin of the remaining rubble area (KY-26 on Figure 1) is thought to be TVA Shawnee Steam Plant material. Seventeen of the rubble areas currently serve or appear to have served a number of functions including bank and erosion control, dam and structural support, and roadway stabilization. The remaining 12 are isolated rubble.

Based on preliminary field reconnaissance, the rubble areas range in size from a 7 ft x 3 ft area that consists of rubble pieces to a 60 ft x 30 ft area forming a wall used for erosion control. The rubble areas include the following varied materials:

- Wood planks
- Railroad ties
- Wooden benches
- Metals stands
- Metal pipes and pieces
- Crushed 55-gal drums
- Metal and concrete culverts
- Plastic dishes
- Cinder blocks
- Clay pipes

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[1] Information is taken from EPA 3007 Request for Information Soil and Rubble Areas, Volume 1, October 2007, Table 1-2, pp.10-16 (PPPO-02-123-08, Enclosure 1).

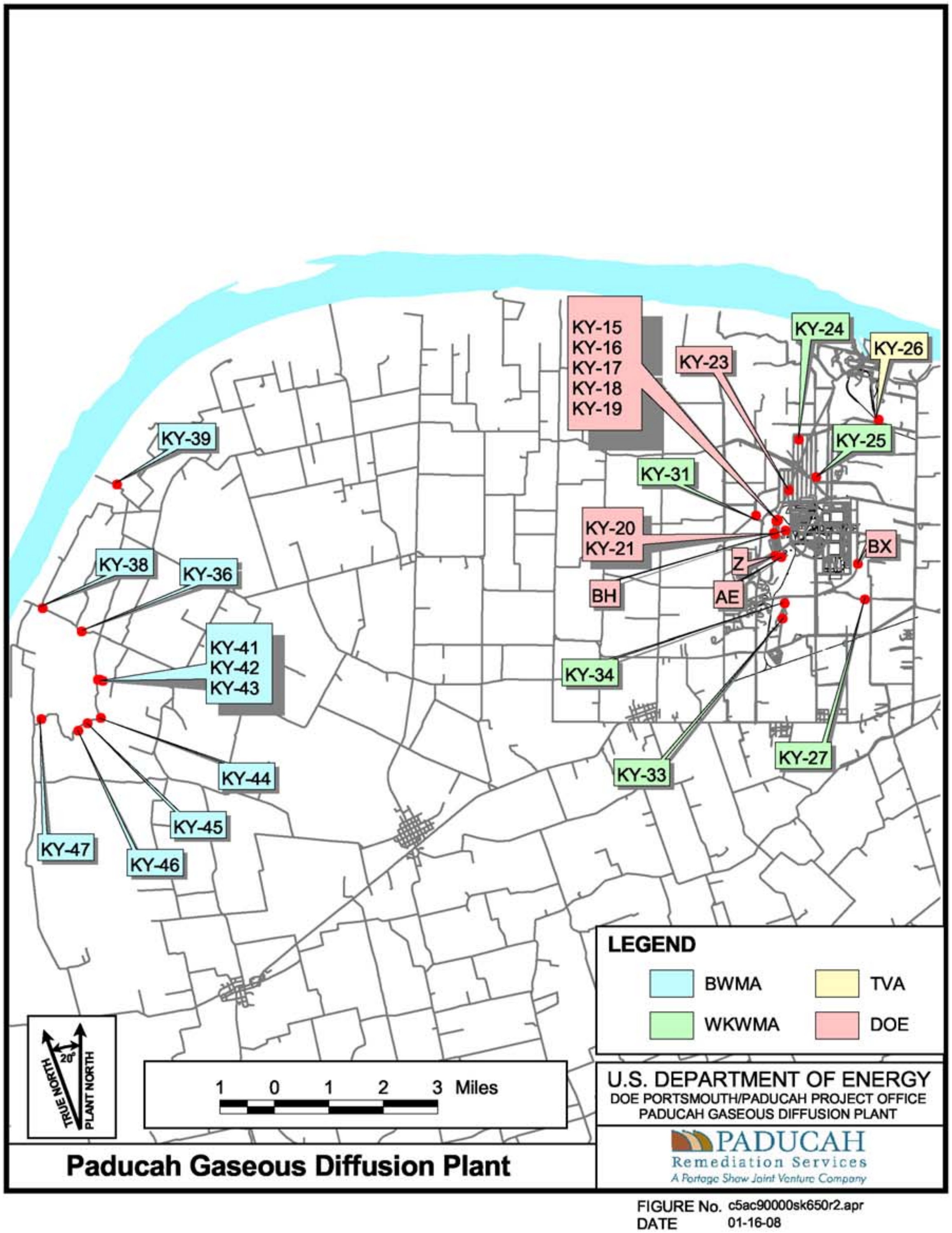

Figure 1. Newly Identified 2006 Rubble Area Locations

1.1 STUDY AREA BACKGROUND

PGDP, located within the Jackson Purchase region of western Kentucky, is an active uranium enrichment facility owned by the DOE. PGDP was owned and managed first by the Atomic Energy Commission and the Energy Research and Development Administration, DOE's predecessors; DOE then managed PGDP until 1993. On July 1, 1993, the United States Enrichment Corporation assumed management and operation of the PGDP enrichment facilities under a lease agreement with DOE. DOE retains ownership of the enrichment complex. The DOE Portsmouth/Paducah Project Office (PPPO) is responsible for certain environmental restoration activities associated with PGDP (CERCLIS # KY8-890-008-982) and serves as the lead agency under the Federal Facility Agreement (FFA) for response actions at PGDP. EPA Region 4 and KDEP serve as the regulatory oversight agencies for the facility.

1.1.1 Previous Studies

Results of previous studies of rubble areas at PGDP and surrounding areas are presented in four reports (IT Corp. 1989; PGDP 1992; CH2M HILL 1992; DOE 1995). Of these studies, the Waste Area Group (WAG) 17 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) (DOE 1995) was the most extensive investigation. During the RFI, 37 Areas of Concern (AOCs) were investigated. The RFI was completed between October and December 1995.

The RFI employed a step-wise approach, which relied on field screening techniques to identify areas of suspected contamination followed by fixed laboratory measurements to quantify potential contamination. The field screening techniques were visual inspection; radioactivity surveys for alpha, beta, and gamma radioactivity; and sampling and analysis using polychlorinated biphenyl (PCB) test kits. Samples were collected for fixed laboratory analysis, if field radioactivity values exceeded local background levels and/or if field PCB results exceeded 1 part per million.

Soil/sediment samples were analyzed in a fixed-base laboratory for radionuclides, target analyte list metals, and PCBs. Organic constituents other than PCBs were excluded from characterization. The following radionuclides were evaluated: technetium-99, thorium-228, thorium-230, thorium-232, uranium-234, uranium-235, uranium-238, neptunium-237, plutonium-239, plutonium-242, and americium-241.

The rubble areas were grouped considering the use of rubble. These groups were as follows:

- Stream bank and erosion control
- Dam and structural support
- Bridge support and erosion control
- Roadway stabilization
- Isolated rubble areas

The WAG 17 RFI was organized further by dividing AOCs into three groups (Category 1, Category 2, and Category 3 AOCs) using results from previous investigations. Table 1 summarizes the logic used in categorizing the rubble areas investigated as part of WAG 17.

Table 1. WAG 17 AOC Categories

Category	Description	Surveys Employed
1	Demonstrated radiological contamination of concrete, soil, or sediment. PCBs and metals associated with PGDP activities also were analyzed.	Radioactivity, PCB, Visual
2	No demonstrated radiological contamination of concrete or soil, but field reconnaissance/process knowledge indicated the possibility of PCB or metals contamination.	PCB, Visual
3	No radiological contamination of concrete or soil; located within areas of known radiological and/or PCB contamination; visually inspected only.	Visual

The findings of the WAG 17 RFI are provided in the remedial investigation (RI) report (DOE 1997a) and in the WAG 17 Record of Decision (DOE 1997b). Appendix B describes the rubble investigated under the RFI.

1.1.2 Newly Identified Rubble Areas

On November 2, 2006, Paducah Remediation Services, LLC, (PRS) radiological control technicians (RCTs) observed and surveyed a series of soil piles on the DOE Reservation. DOE notified EPA, KDEP, and Kentucky Department of Wildlife Management. Following notification, KDEP identified additional rubble areas. DOE also began additional surveys to identify any other soil and rubble areas. Fifty-one rubble areas were identified. Twenty-two rubble areas previously were investigated under the WAG 17 RFI, and 29 areas newly identified by KDEP and DOE were determined to require additional investigation. Appendix C provides descriptions and photographs of the newly identified rubble areas.

2. PROJECT ORGANIZATION AND RESPONSIBILITIES

The following subsections outline the specific duties of key project positions.

2.1 PROJECT MANAGER

The PRS project manager (PM) is responsible for the overall work scope, schedule, and budget. The PM will ensure that all survey/sampling activities comply with PGDP work control procedures and job-specific work packages and applicable Occupational Safety and Health Administration, EPA, DOE, U.S. Department of Transportation, and Commonwealth of Kentucky requirements. The PM will coordinate project personnel, planning, field activities, laboratory procurement, data validation and evaluation, and document preparation. As described in Section 5 of the SAP, the project manager also will be responsible for determining if a rubble area is "accessible" or "not accessible" based on data collected during the initial rubble survey. This real-time decision making will determine which rubble areas on DOE property are removed as maintenance actions and facilitate evaluation of soils underlying removed rubble and other remaining SAP tasks detailed in Section 5.

2.2 PROJECT QUALITY ASSURANCE OFFICER

The project quality assurance officer (PQO) is responsible for ensuring all field, laboratory, data management, data validation, and evaluation activities are completed in accordance with this SAP. During survey/sampling efforts, the PQO will complete the following specific duties:

- Coordinate with the PRS Sample Management Office (SMO) to ensure laboratory statements of work (SOWs) and related requirements comply with project quality and schedule requirements;
- Review all field sampling related technical documents and documentation to ensure accuracy and compliance with project requirements;
- Coordinate with the field team to ensure personnel understand and are able to execute field objectives/requirements;
- Perform periodic inspections to ensure project quality; and
- Oversee data validation and evaluation efforts to ensure accuracy and timeliness of the products.

2.3 PROJECT HEALTH AND SAFETY OFFICER

The project health and safety officer (HSO) is responsible for overseeing planning and field activities relative to survey/sampling efforts to ensure all federal, state, and site-specific work control requirements have been met prior to initiating work. The HSO will report directly to the PRS environment, safety, and health (ES&H) manager and will work closely with the PM, the field team lead (FTL), and field personnel to ensure all work activities are completed in a safe manner. Specific duties to be completed by the HSO include, but are not limited to, the following:

- Ensuring field activities comply with the project ES&H plan and site-specific work control requirements;
- Documenting site conditions daily to monitor changing site conditions;
- Continuously monitoring field activities and personnel as necessary to ensure a safe work site;
- Documenting incidents related to worker safety on the job site;
- Creating and implementing on-site corrective actions for changing work conditions; and
- Specifying, providing, and inspecting personal protective equipment (PPE) necessary for site workers and site conditions.

2.4 FIELD TEAM LEADER

The FTL is responsible for the safe and successful completion of survey/sampling efforts. The FTL will conduct daily pre-job briefings and will coordinate with the PM, HSO, RCTs, and field team to manage field operations and execution of this SAP. The FTL enforces site control, documents daily field activities, and conducts the daily operational and safety briefings at the start of the work shift at the discretion of the PM. Any team member may bring health and safety issues to the attention of the FTL at any time. Should the FTL be absent from the site, an alternate will be appointed prior to initiation of daily field activities. The identity of the acting FTL will be conveyed to all project personnel, recorded in the field logbook, and communicated to the PM, as appropriate.

2.5 RADIOLOGICAL CONTROL TECHNICIANS

The RCTs will provide on-site monitoring for all field activities to ensure the work environment is safe for sampling personnel. The RCTs will verify that all field personnel are properly trained and equipped prior to entry into radiologically controlled/contaminated areas. The RCTs also will monitor conditions in the field to ensure changing conditions do not warrant additional PPE or evacuation of the site due to an unsafe work environment. The RCTs will coordinate, at a minimum, daily with the HSO to ensure all field sampling activities are being performed in accordance with project and program requirements.

As part of field support activities, the RCTs will provide field radiological screening during sample collection. This effort will provide basic field screening information to the project to be used following data collection to determine if field radioactivity measurements can be correlated to laboratory data and used as a characterization tool in the future. Additionally, the RCT will screen sample coolers daily or when they reach capacity to support sample transport and preparation for shipment to the analytical laboratory.

As part of the rubble survey and sampling effort, the RCTs will serve as the lead for performing surface radioactivity surveys. The RCT, or properly trained designee, will perform surface surveys of 100% of the exposed surfaces on each portion of rubble.

2.6 SAMPLING TEAM MEMBERS

The sampling team will consist of individuals who are properly trained and skilled in the execution of the sampling procedures defined in this SAP. Sampling team members are responsible for safe conduct of work at all times and are responsible for collecting, preserving, handling, and storing samples in accordance with the provisions of the SAP.

Sampling team members will be experienced in environmental investigation field techniques, familiar with site conditions, and experienced in using sampling techniques and equipment similar to those defined herein. Sampling team members will participate in a daily pre-job briefing addressing the job scope and hazards specific to the planned activities for the day. Prior to participation in field sampling activities, each field team member will demonstrate that he/she has read and understands all applicable PRS safety and health procedures, policies and manuals, sampling procedures prescribed in this SAP, and all site-specific safety procedures and related work packages.

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3. DATA QUALITY OBJECTIVES SUMMARY

The primary objective of this rubble areas SAP is to determine if contamination from the PGDP is present in the rubble and/or the soils contacting rubble. If that is so, define the nature and extent of contamination to determine if future action is necessary.

3.1 CONCEPTUAL SITE MODEL

The following information describes the Conceptual Site Model for the rubble areas (see Figure 2). Recreational activities known to take place in and around the PGDP rubble areas include the following:

- Bow Hunting
- Field trials (horses and dogs)

Although not authorized, other recreational uses such as hiking also are possible; therefore, recreational user exposure to rubble or to surface soils potentially contaminated by rubble is the primary exposure pathway. The recreational user could be exposed to contaminants through contact with rubble or with surface soils potentially contaminated by rubble through the following exposure routes:

- External exposure (ionizing radiation) (most likely)
- Dermal contact
- Incidental ingestion
- Inhalation

Recreational user exposure through the dermal contact, incidental ingestion, and inhalation exposure routes is limited given that most rubble areas and soils or sediments in the adjoining areas are covered by vegetation continually. Industrial worker exposure would be similar for nonintrusive activities.

Rubble areas proximal to surface water drainage areas (see Appendix C) could result in several potential secondary exposure routes for human health and the environment. The majority of the secondary routes assume contaminants either have been released to adjacent waterways or moved through the food chain. Precipitation could result in contaminant migration from the rubble areas.

The majority of the contaminants found during the 1995 WAG 17 RFI relative to rubble, do not bio-accumulate in plants to a great degree. As a result, plant uptake and corresponding accumulation in animal tissue is unlikely, but soil ingestion as part of normal feeding activities may be a complete pathway if surrounding soils and sediments are contaminated. Ecological receptors also may be exposed to on-site contaminants; however, the primary focus of the characterization effort is to determine risks to human health.

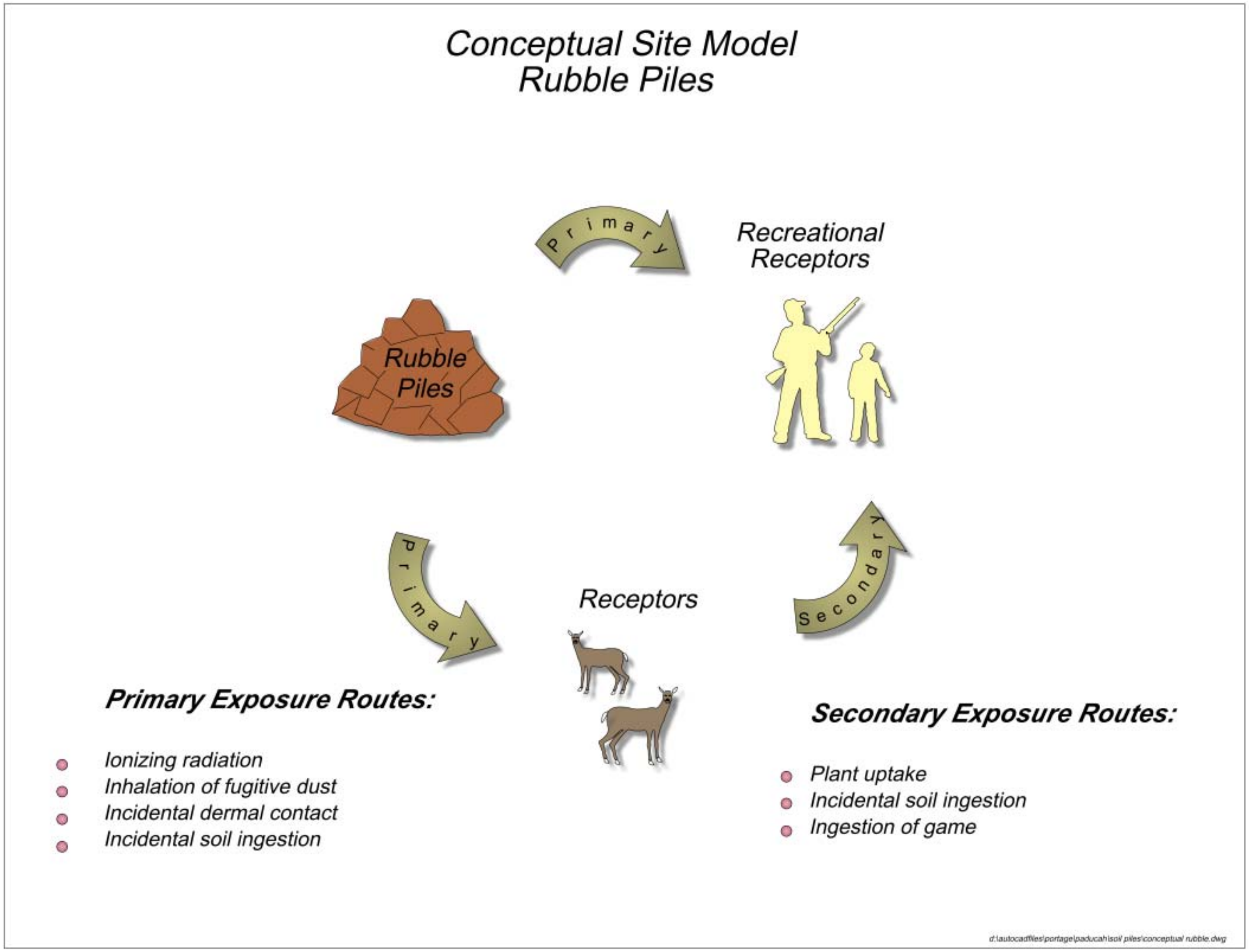

Figure 2. Conceptual Site Model

3.2 PROBLEM STATEMENT

Newly identified rubble areas require characterization to determine if contamination from PGDP is present and, if so, develop information to determine if an action is necessary. Historical investigations of similar rubble (WAG 17), in addition to the 2006 radioactivity survey data, do not indicate widespread chemical or radionuclide contamination in the rubble areas. Based on observed radiological and/or chemical conditions, evaluation of soils contacting the rubble may be required following rubble removal.

3.3 DECISION STATEMENTS

This SAP must acquire the appropriate field observations and field and laboratory data to meet the data quality objectives (DQOs) and answer the underlying study questions:

- Are the rubble areas not previously addressed by a maintenance action easily accessible (can drive to them and pick up pieces by hand)?
- Are they serving an intended purpose?
- Do the rubble areas pose a safety hazard?
- Are the rubble areas contaminated?
- If rubble has been removed by a previous DOE maintenance action, is the soil underlying the rubble contaminated?
- Are rubble areas on DOE property?
- Did the rubble areas originate from PGDP?

The actions that address these study questions are as follows:

- Obtain Global positioning system (GPS) coordinates and map rubble areas.
- Survey the rubble on any exposed, accessible surface (without moving the rubble) to determine if radioactivity is above background.
- Visually determine if rubble on DOE property contains oil staining.
- Sample the soil beneath the rubble, if rubble is contaminated, for radionuclides and chemicals if necessary (see Section 5.1.1).
- Determine if rubble size or physical condition pose unsafe conditions.

Observations and field and laboratory data will be used to develop a Site Evaluation Report (SER). The SER will include the findings of investigative activities and form the basis for development of decision documents, if required.

3.4 DECISION INPUTS

The decision inputs for the rubble areas are as follows:

- The location of the rubble areas (on or off DOE property).
- Current use of the rubble areas.
- Institutional knowledge about the origin of rubble area material.
- Visual inspection of the rubble areas.
- Radiation screening of the rubble areas and soils if required.
- Chemical characterization of soils if required.

3.5 STUDY BOUNDARIES

The rubble areas are located both on the DOE Reservation and on adjacent lands owned by TVA, WKWMA, and BWMA, Kentucky. Specifically, (a) 12 rubble areas have been identified on DOE property, 4 of which are on property licensed to the WKWMA; (b) 1 has been identified on TVA property; (c) 6 rubble areas have been identified within the WKWMA, off DOE owned property; and (d) 10 rubble areas have been identified on BWMA, off DOE-owned property.

The study area is bounded by the distance at which contaminant survey results or field methods screening results do not indicate contamination present exceeding the criteria established in Section 5.1.1.1 of this SAP. Section 5.1.2.4 of this SAP establishes the methodology for defining the spatial extent of the study area.

3.6 DECISION RULE

Application of decision rules is described in Section 5 of this SAP.

3.7 DECISION ERROR LIMITS

The purpose of this step is to minimize data uncertainty by specifying tolerable limits on decision errors used to establish performance goals for the data collection design. It is necessary to determine the possible range for the parameter of interest and to define both the types of decision errors and the potential consequences of the errors.

A systematic field radioactivity survey, in addition to biased sampling, will be employed. The sampling approach is expected to characterize concentrations in areas approximately 10 ft x 10 ft.

4. DOCUMENTATION AND SAMPLE CONTROL

Documentation involves the recording of all events relating to field and laboratory activities and the retention of these records. Sample control describes the process of documenting sample related records and defining how samples are to be handled from collection through reporting of analytical data. To ensure that all sampling, analysis, and data reporting activities are conducted in accordance with the project DQOs and applicable safety requirements, adequate documentation of each event must be completed in accordance with site procedures.

4.1 DOCUMENTATION

Field activities related to rubble observations, sample collection, preservation, custody, handling, and transport/shipment and all activities relating to site safety will be made a part of the project record. This documentation will include specific records relating to sample location, collection, field screening results, and a complete copy of chain-of-custody records. All sample-specific and daily activities and deviations from this SAP will be recorded by the FTL and/or the field team members in the field logbook in accordance with site procedures.

Laboratory activities relating to sample custody, sample preparation, sample analysis, and data reporting will be documented by the contract laboratory to ensure samples and sample data are traceable to their origin. This will include retention of all laboratory records including chains-of-custody, logbooks, data packages, and supporting raw data. Analysis of project samples will be completed by a DOE - Consolidated Audit Program (DOE-CAP) approved laboratory, with a demonstrated ability to produce data of known quality. In addition, the selected laboratory will have the appropriate certifications to support waste disposition at the landfill. The PRS SMO will serve as the interface with the contract laboratory and will provide direction related to sample analysis through the laboratory SOW, this SAP, and communications with the PM. The PRS SMO also will submit chains-of-custody, data assessment packages, data validation reports, and laboratory data packages to the Document Management Center in accordance with site procedures.

4.1.1 Field Operations Records

The following subsections provide a summary of requirements for adequate field documentation. All field documentation, document control, and daily updating of field logbooks and field materials will be the responsibility of the FTL or designee.

4.1.1.1 Field logbooks

Logbooks are maintained to ensure that field activities are properly documented. The creation and use of field logbooks will be completed in accordance with PGDP procedure PRS-ENM-2700, *Log Books and Data Forms.*

4.1.1.2 Chain-of-Custody records

All samples collected during rubble area sampling efforts will be managed via chains-of-custody. The chains-of-custody will be completed in accordance with the PGDP procedure PRS-ENM-2708, *Chain of Custody Forms, Field Sample Logs, Sample Labels, and Custody Seal*.

4.1.2 Laboratory Records

Laboratory records consist of all information, records, and data generated as part of sample receiving, storage, preparation, analysis, and reporting. Documentation of all activities and information associated with laboratory processing of samples is required to ensure the traceability of sample data and will be managed in accordance with PRS-DOC-1009, *Records Management, Administrative Records and Document Control*. The following subsections describe the key laboratory records that will be generated for this project.

4.1.2.1 Sample management records

Sample management records include field logbooks, internal custody records, and instrument/analyst logbooks identifying when samples were prepared and analyzed. Sample management records also include identification of any discrepancies with sample handling, preservation, labeling, etc., by laboratory personnel at the time of receipt or identification of those discrepancies that occurred in the laboratory.

4.1.2.2 Quality control records

Quality control records document preparation and analysis of laboratory batch and instrument quality control used to verify the accuracy of sample analysis. Quality control records also include documentation of the industry or agency source where standards were obtained (certificates of analysis), internal standard preparation logbooks, instrument logbooks, control charts, and all other record keeping techniques associated with the monitoring of method/instrument effectiveness during sample analysis. Specific requirements for analysis frequency of QC samples will be specified in the analytical methods and the laboratory SOW. Reporting requirements are detailed in Section 8.

4.2 SAMPLE CONTROL

The key element of the PGDP infrastructure for documenting sample control is Project Environmental Measurement System (PEMS). To ensure sample control is properly completed and documented, PGDP sample control SOPs are applied to all sample-related activities. The two primary PGDP procedures governing sample control are (1) PA-5004, *Sample Tracking, Laboratory Coordination and Sample Handling Guidance* and (2) ES-1510, *Subcontracting Analytical Work and Sample Material Tracking.* (Both will be replaced with PRS-ENM-5004, *Sample Tracking Laboratory Coordination and Sample Handling Guidance*).

Once sample planning is complete, the total number of samples, analysis types, preservation requirements, bottle requirements, and unique sample numbers are entered into PEMS by the PRS Data Manager or designee. PEMS then generates unique sample identification numbers and places them on chain-of-custody forms at the frequency specified in the SAP. An example sample number to be employed for the rubble areas would be RPKY16RU-01. The components of the numbering scheme are described as follows:

- RP = Rubble Area
- KY-16 = Rubble Area Designator
- RU = rubble sample
- 01 = sequential number denoting first composite, second composite, etc.

PEMS also generates unique sample identifications and the analyses required, preservatives, etc., for individual sample containers. In general, PEMS uses site-specific information to identify samples in a manner that will ease data users in tracing sample identifications back to individual locations. PEMS will not be used to generate field logbooks, due to the incorporation of field measurement techniques into the sampling regimen. Instead, field logbooks will be developed by the FTL to incorporate all field observation requirements necessary to complete soil sampling and analysis activities.

4.3 DOCUMENT CONTROL

For the rubble area effort, the PGDP document control system will be employed. It combines a series of standard procedures with the operating infrastructure of the PRS information management and archival system to ensure the distribution of project information is organized and controlled. The PRS Document Manager and the PRS Data Manager oversee the document control program. They employ the basic infrastructure of PEMS, Paducah Oak Ridge Environmental Information System (OREIS), and the Document Control Center to capture and manage project information. The specific activities of the program are governed by the following PRS implementing procedures:

- PRS-DOC-1009, *Records Management, Administrative Records and Document Control*

- PRS-ENM-1002, *Submitting, Reviewing, and Dispositioning Changes to the Environmental Databases (OREIS and PEMS)*

- PRS-ENM-1001, *Transmitting Environmental Data to the Paducah, Oak Ridge Environmental Information System OREIS*

- PA-5003, *Quality Assured Data – Paducah* (PRS-ENM-5003, *Quality Assured Data*)

- GEO-TEC-007, *Data Management Coordination* (PRS-ENM-5007, *Data Management Coordination*)

These procedures will used as the basis for document control throughout the rubble area survey/sampling effort and as the means of managing the Administrative Record for the project following its completion.

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5. RUBBLE SURVEYS AND SAMPLING APPROACH

5.1 BACKGROUND

The WAG 17 investigation strategy, 2006 radiation survey data, historical site knowledge, and input from the regulatory agencies were used to determine the planned approach to meet the DQOs.

5.1.1 Approach

The approach for the rubble areas is consistent with industry standard guidance. Similar studies such as WAG 17, in addition to 2006 radiological survey data, indicate there is no widespread contamination in rubble areas; however, these rubble areas have the potential for contamination because they may have come from PGDP structures having the potential for low levels of contamination. The planned approach is illustrated in Figure 3.

All areas will be visually inspected and radiologically surveyed, with GPS coordinates documented.

5.1.1.1 Evaluation of rubble *not* on DOE property

The origins of rubble areas on lands held by TVA, WKWMA, or BWMA are unknown. The emphasis of the survey effort for rubble not on DOE property is to evaluate and document radiological condition, and to visually inspect and obtain GPS coordinates. This information will be documented in the SER.

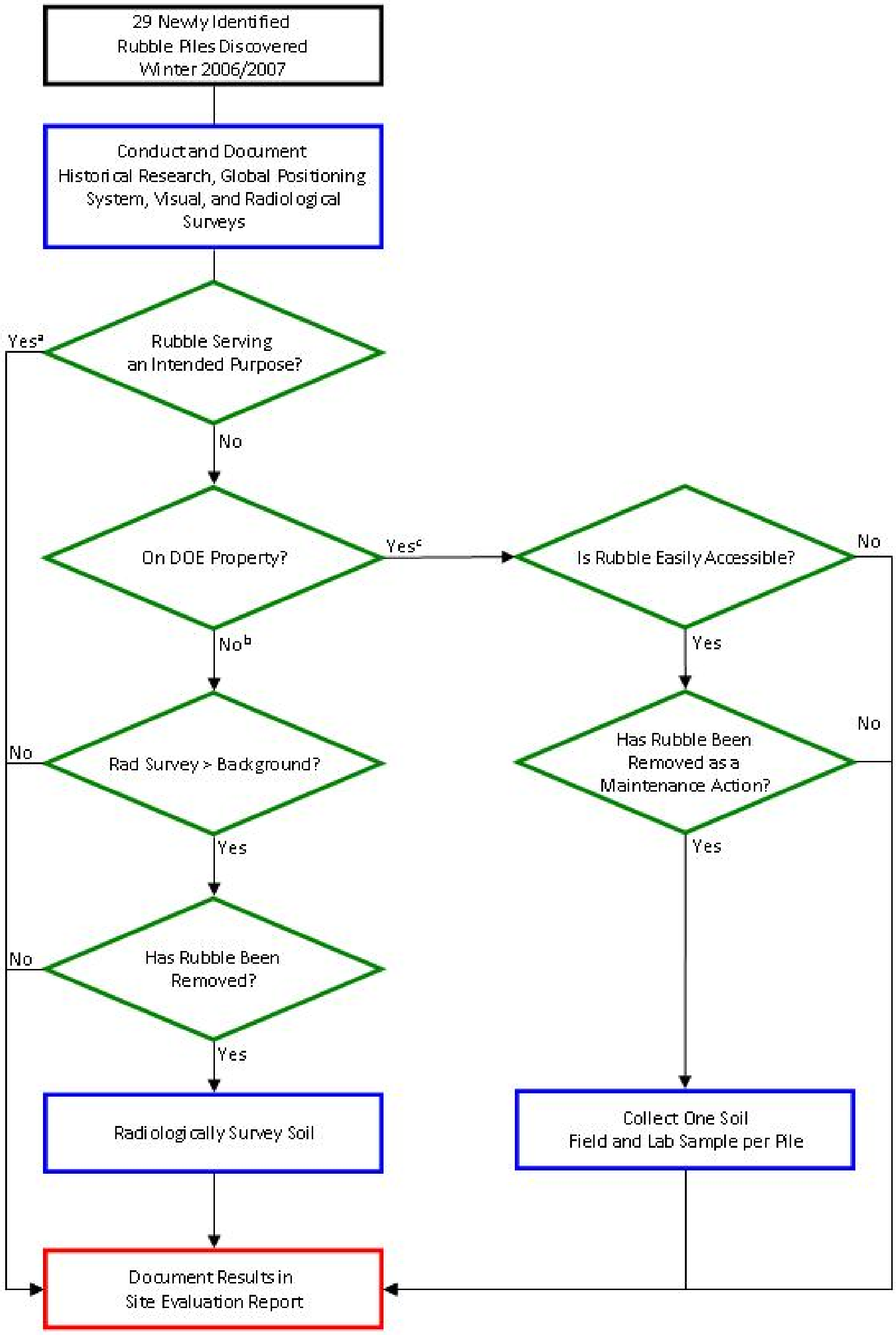
Seventeen of the rubble areas are not on DOE property: one on TVA property; six on the WKWMA; and ten on BWMA.

5.1.1.2 Evaluation of rubble serving a beneficial function on and off DOE property

Rubble areas serving a beneficial function will be visually inspected and radiologically surveyed with GPS coordinates documented. This information will be documented in the SER. Examples of rubble serving a beneficial function include the following:

- Stream bank and erosion control
- Dam and structural support
- Bridge support and erosion control
- Roadway stabilization

The number of rubble areas serving a beneficial function is 11; however, 5 of them are located on WKWMA (2) and BWMA (3), and these 5 are included in the 17 rubble areas not on DOE property noted above. Six areas serving a beneficial function are located on DOE property. See Appendix C.



Sampling Approach for Newly Identified Rubble Piles

[a] 11 piles serving an intended purpose (2 West Kentucky Wildlife Management Area, 3 Ballard Wildlife Management Area, and 6 DOE)
[b] 12 piles not on DOE property and not serving an intended purpose
[c] 6 piles on DOE Property and not serving an intended purpose

Figure 3. Sampling Approach for Newly Identified PGDP Rubble Areas

5.1.1.3 Evaluation of rubble areas that DOE plans to remove as a maintenance activity and on DOE property

For rubble in five areas (KY-18, KY-23, AE, BH, and BX) that DOE plans to remove as a non-CERCLA maintenance activity,[2] the following steps will be taken to verify that underlying soils are not contaminated:

- Conduct and document a 100% radiological survey of all underlying soil surfaces.
- Examine all underlying soil and/or sediment surfaces for oil staining.
- Collect one soil sample from beneath each pile for parameters identified in Table 2 as detailed in 5.1.3.

5.1.2 Surveys

Each rubble area, including a 3-foot buffer zone surrounding the rubble, will be visually inspected, radiologically surveyed, and surveyed using GPS.[3]

The following field observations will be documented in the project field logbook as applicable for each rubble area.

- Can the area be accessed by driving in a car?
- Are there any markings on the concrete that indicate where it may have originated?
- Are there any physical characteristics associated with the rubble that pose obvious hazards?
- Are there any oil stains on the surface of the rubble?
- Would the size of any rubble allow members of the public to remove it by hand (< 1 ft^2)?
- Is the rubble currently serving a beneficial function (e.g., stream bank stabilization)?
- Does the radiological survey indicate readings greater than background?
- What are the four point GPS readings?

5.1.3 Sampling

The following sections detail the process that will be used to collect samples from soil underlying any rubble areas on DOE property removed as a non-CERCLA maintenance activity.

One surface soil grab sample (0–1 ft) will be collected at the lowest point beneath the removed pile.

Soil samples will undergo field X-ray florescence (XRF) measurements for RCRA metals, total uranium, and PCB field measurements. The sample(s) collected following removal also will be submitted for the following fixed laboratory analyses: (a) radiochemistry, (b) total metals, (c) PCBs and asbestos. Table 2 identifies the constituents that will be characterized using fixed laboratory analyses. If required, this approach will support sampling for both elevated radioactivity and any observed oil staining.

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[2] The plans described herein regarding DOEs intention to remove rrubble as a non-CERCLA maintenance action are provided for informational purposes only. These and any other non-CERCLA maintenance actions are not subject to the requirements of CERCLA and the FFA. All rubble will undergo a 100% surface radioactivity scan prior to its removal to support waste disposal/comparison against free release criteria.

[3] Surveying will be completed using a Trimble GPS with accuracy error rates <1 meter.

Table 2. Fixed Laboratory Analyses for Soil Sampling

Analysis	CRDL[a]	Analytical Method:	Analysis	CRDL	Analytical Method:
PCBs (Aroclors/Total)	60 µg/kg	EPA 3540/8082	**^{235}U wt% (enrichment)**	--	DOE EML HASL-300, U-02-RC
Gamma-emitting radionuclides	0.1 pCi/g	EML HASL 300, 4.5.2.3.	**Uranium-238**	0.05 pCi/g	DOE EML HASL-300, U-02-RC
Americium-241	0.05 pCi/g	DOE EML HASL-300, Am-05-RC	**Arsenic**	1 mg/kg	EPA 6010 or 6020
Neptunium-237	0.05 pCi/g	DOE EML HASL 300	**Barium**	0.35 mg/kg	EPA 6010 or 6020
Plutonium-239/240	0.05 pCi/g	DOE EML HASL-300, Pu-11-RC	**Cadmium**	0.5 mg/kg	EPA 6010 or 6020
Thorium-228	0.05 pCi/g	DOE EML HASL-300, Th-01-RC	**Lead**	0.3 mg/kg	EPA 6010 or 6020
Thorium-230/232	0.05 pCi/g	DOE EML HASL-300, Th-01-RC	**Mercury**	0.2 mg/kg	EPA 7470
Total Uranium	0.05 pCi/g	DOE EML HASL-300, U-02-RC	**Selenium**	0.5 mg/kg	EPA 6010 or 6020
Uranium-234	0.05 pCi/g	DOE EML HASL-300, U-02-RC	**Silver**	1 mg/kg	EPA 6010 or 6020
Uranium-235 radioactivity	0.05 pCi/g	DOE EML HASL-300, U-02-RC	**Zinc**	2 mg/kg	EPA 6010 or 6020
Plutonium-238	0.05 pCi/g	DOE EML HASL-300, Pu-11-RC	**Asbestos**	Pass/Fail	ASTM D 6480-05
			Chromium	1 mg/kg	EPA 6010 or 6020

[a] CRDL = contract required detection limit

5.1.4 Survey and Sampling Implementation Techniques

Data acquisition will rely on both field measurements and fixed laboratory data to determine if contamination issues exist in the underlying soils (when rubble is removed as a maintenance action), and field measurements will be used only on the rubble areas. Field screening and visual inspection will comprise most of the initial data gathering, with laboratory and *ex situ* field analysis occurring only to support investigation of areas of suspected contamination. Field methods will include field radioactivity measurements using a GM Probe©. Field methods for soils and/or sediment underlying removed rubble will include RCRA metals + uranium using XRF and PCBs using immunoassay/colorimetric test kits.

The following standard operating procedures will be used for the calibration, maintenance, and use of noted field methods:

- PRS-RAD-0506, *Radiological Protection Operating Guide*

- PRS-RAD-1309*, Setup for Operability Tests of Portable Field Instruments*

- Method 6200, "*Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment*

- *NITON XLi 700 Series Environmental Analyzer User's Guide*

- *Hach Pocket Colorimeter™II Test Kit Immunoassay Instruction Manual*

If other models, vendors or contractor procedures are employed for field methods, the procedure for its operation will be added to the required reading for this SAP and the associated work package. All field methods shall be completed by a properly trained/qualified technician.

5.1.4.1 Determination of radioactivity

RCTs or properly qualified designee(s) will perform a local environmental background determination for beta and gamma radioactivity using the GM Probe©. Prior to its use, the GM Probe© will be calibrated and operated in accordance with (1) PRS-RAD-0506*, Radiological Protection Operating Guide*, and (2) PRS-RAD-1309*, Setup for Operability Tests of Portable Field Instruments*.

Concrete/Soil. The slabs or rubble used to determine background values should be composed of native materials similar to those present in the rubble piles concrete and should be approximately the same age (i.e., 30 years in age). At a minimum, three background sites (e.g., Kevil Post Office, BWMA) should be identified for the purpose of establishing background values. Background values for both concrete and soils will be determined at each of the selected sites. Measurement of background for comparison purposes will be in disintegrations per minute. Eight readings will be taken for both concrete and soil at each background site, with the readings measured at several different points on the concrete and surrounding ground surface where soil is exposed. The background level used for comparison purposes for both concrete and soil will be the mean of all the background readings from all sites and the 95% confidence level determined by the standard deviation of the readings (after testing the normality of the distribution).This approach is consistent with the determination of concrete background radiation levels completed for the WAG 17 RFI.

Upon completion of the appropriate background determination, a complete surface scan of all exposed rubble or soil/sediment surfaces will be completed using a GM probe©. The instrument will record measurements of beta and gamma activity emitted from rubble surfaces. All recorded measurements will be documented.

5.1.4.2 Determination of metals using X-ray fluorescence

Survey and verification field samples will undergo *ex situ* XRF analysis for RCRA metals and total uranium. The XRF sample will consist of a minimum of 20 grams of soil. Samples will be collected, air-dried, and homogenized prior to analysis in accordance with PRS procedure PRS-ENM-2300 *Collection of Soil Samples*.

To further ensure the defensibility of XRF data, periodic performance checks and blanks will be performed to monitor instrument drift. The frequency of calibration verification samples and blanks will be 1 each for every 20 samples analyzed. They will be analyzed sequentially; (1) calibration verification and (2) a blank analysis will follow the 20th natural sample analyzed or at the end of a group of samples, whichever is more frequent. Along with each batch of samples totaling 20 or less, an independent standard reference material (SRM) will be analyzed. The SRM will have a concentration within the calibration and will have verifiable levels documented by a certificate of analysis. Data outputs will be stored in the instrument and duplicated in the field logbook or spreadsheet to ensure sample results are fully documented in the event of an instrument failure.

5.1.4.3 Determination of PCBs using field test kits

Field samples will undergo field PCB analysis using methanol extraction and colorimetric analysis. A minimum of 20 grams of soil will be collected for PCB analysis. To ensure PCB data can be fully evaluated, a pre-weighed aliquot of each sample will be extracted and analyzed, and the colorimeter will be calibrated with each analytical batch in accordance with the manufacturer's specifications. All test kits and reagents (i.e., calibration standards, calibration verification standards, standard reference materials, kit reagents, and blanks) will be prepared and stored in accordance with the method requirements.

Because the cuvettes and reagents in the PCB kits are in matched lots, each analytical batch is limited to the number (20) provided in each kit. Calibration standards and a reagent blank will be analyzed with each analytical batch prior to sample analysis. Along with each batch of samples totaling 20 or fewer, an independent SRM will be analyzed to verify the method detection limit (MDL), to establish precision and accuracy, and to estimate extraction efficiency. The SRM will have a concentration within the operating range of the colorimeter calibration and will have verifiable levels documented by a certificate of analysis. If another vendor provides the PCB test kits, their standard operating procedure will be added to this addendum. PCB field analysis shall be completed by a properly trained/qualified technician.

5.2 FIELD QUALITY CONTROL SAMPLES

Field quality control samples will include the following: field duplicates and field blanks. Both field duplicates and field blanks will be collected and analyzed at a frequency of 1 for every 20 samples collected or 5%.

Subsurface sampling is not anticipated for the rubble verification effort; therefore, equipment rinseates are not planned. Should field conditions dictate that subsurface sampling is required, equipment rinseates will be collected at a frequency of 1 rinseate for every 20 samples collected or 5%.

5.3 SOIL SAMPLING

The following provisions will apply to all sampling activities. Surface soil samples will be collected using disposable, stainless steel scoops to minimize the quantity of investigation-derived waste (IDW), particularly liquid waste, generated during sample collection.

The following provides a general equipment/supplies list for the sampling activities. The list assumes site and sample location surveying is completed separately as part of civil survey efforts and site preparation. Area-specific sampling approaches and PRS procedures identify specific equipment requirements.

- Site-specific ES&H Plan
- PPE, including, but not limited to, steel toed boots, safety glasses, gloves, bug suits
- Dosimeter (as required)
- Site-specific SAP
- Field logbook
- Chain-of-custody forms

- Sample labels
- Custody seals
- Sample containers (bottles)
- Shipping/transport paperwork
- Laboratory address
- Laboratory shipping/receiving contact
- Surgical gloves
- Stainless steel scoops
- Sorbent material
- Nylon brush (dry decontamination)
- Blue ice
- Deionized water
- Cooler(s)
- Adhesive tape (e.g., clear, duct, and strapping)
- Pens and markers
- 100-ft tape measure
- Zipper-sealing plastic bag
- Parafilm©
- Utility knife

5.4 FIELD DECONTAMINATION PROCEDURE FOR SAMPLING EQUIPMENT

As noted, subsurface sampling is not anticipated for the rubble verification effort. Should field conditions warrant subsurface sampling, key priorities when performing field sampling activities and decontamination include cross-contamination and waste minimization. Sampling team members must always be aware of the risk of cross-contamination between sample locations when acquiring reusable sampling devices. To minimize cross-contamination, disposable sampling equipment will be employed for the collection of all surface grab and composite samples to the greatest extent possible.

Decontamination will be completed in accordance with PRS Procedure PRS-ENM-2702, *Decontamination of Sampling Equipment and Devices*. Field samplers will do the following:

- Remove excess material using dry decontamination techniques prior to performing wet decontamination;
- Segregate nonliquid materials for storage and disposal;
- Capture liquids used in decontamination in an appropriate waste container for future treatment/disposal;
- Have sufficient quantities of sorbent on hand to prevent decontamination liquids from being released;
- Ensure sampling equipment/devices are thoroughly cleaned prior to their reuse; and
- Collect sufficient numbers of equipment rinseate blanks (5% of total sample numbers collected using non-disposable sampling equipment) to ensure an evaluation of cross contamination can be completed.

5.5 SAMPLE HANDLING

Sample handling incorporates all aspects of sample preservation, custody, storage, and transportation following the collection of samples. To ensure the complete traceability of sample data to individual sample locations, field samplers must ensure that each step of the sample collection and sample handling process is fully documented. The samplers also will comply with industry standard requirements. To ensure all elements of the characterization efforts are fully transparent and documented, sample handling will be completed in accordance with the following specific PRS procedures:

- PA-5004, *Sample Tracking, Laboratory Coordination and Sample Handling Guidance* (PRS-ENM-5004, *Sample Tracking, Laboratory Coordination and Sample Handling Guidance*)

- ES-1510, *Subcontracting Analytical Work and Sample Material Tracking* (PRS-ENM-5004, *Sample Tracking, Laboratory Coordination and Sample Handling Guidance*)

- PRS-ENM-2700, *Logbooks and Data Forms*

- PRS-ENM-2708, *Chain of Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*

- PRS-DOC-1009, *Records Management, Administrative Records and Document Control*

5.6 SAMPLE PRESERVATION

Preservation requirements are specific to the analyses performed for each sample. Because all of the anticipated media to be collected for rubble areas are solid (soil), preservation generally will involve cooling of samples after collection. Addition of chemical preservatives (e.g., nitric acid) will not be required for natural samples. Preservatives will be required for liquid trip blanks (volatile organic compounds), field blanks (all parameters), and equipment rinseate blanks (all parameters). Table 3 lists general preservation requirements for project samples including water samples collected for quality control purposes.

Table 3. General Preservation Requirements for Soils Contacting Rubble Areas

Analysis Request	Media	Cool 4oC +/-2oC	Chemical Preservative	Special Handling
PCBs	Soil	Yes	NR	None
PCBs	Liquid	Yes	NR	None
Metals	Soil	Yes	NR	None
Metals	Liquid	Yes	HNO_3 to pH <2	None
Radionuclides	Soil	No	NR	None
Radionuclides	Liquid	No	HNO_3 to pH <2	None
Asbestos	Solid	No	No	None

Table 4 provides the project-specific sample container, preservation, and holding time requirements for the specified analytical methods

Table 4. Soil Sample Container, Preservation, and Holding Time Requirements

Analyte	Container Type*	Holding Time	Preservative
PCBs (Aroclors/Total)	Glass	14 days sample to extraction, 40 days extraction to analysis	4 °C +/- 2 °C
Radionuclides	HDPE, Glass	180 days	None
Arsenic	HDPE	180 days	4 °C +/- 2 °C
Barium	HDPE	180 days	4 °C +/- 2 °C
Cadmium	HDPE	180 days	4 °C +/- 2 °C
Chromium	HDPE	180 days	4 °C +/- 2 °C
Lead	HDPE	180 days	4 °C +/- 2 °C
Mercury	HDPE	28 days	4 °C +/- 2 °C
Selenium	HDPE	180 days	4 °C +/- 2 °C
Silver	HDPE	180 days	4 °C +/- 2 °C
Zinc	HDPE	180 days	4 °C +/- 2 °C
Asbestos	HDPE, Glass	N/A	N/A

* Toxicity Characteristic Leaching Procedure (TCLP) analyses will be completed in accordance with the specific instructions provided in Section 5.7. Sample volume(s) required to perform TCLP analyses will be acquired from a separate container(s) from that used for total VOC analyses.

HDPE = high density polyethylene

5.7 TCLP ANALYSES

As part of the planning process, the PRS SMO will provide instructions to the contract laboratory as specific language in the laboratory SOW, directing the performance of Toxicity Characteristic Leaching Procedure (TCLP) analysis. Samples where the total concentration of an Underlying Hazardous Constituent exceeds 20 times the TCLP limit (Table 4) will undergo TCLP analysis.

The laboratory SOW will identify this activity as a hold point for the laboratory. If samples are identified with contaminant levels exceeding 20 times the TCLP limit, laboratory personnel will contact the PRS SMO laboratory coordinator who will notify the PM. If multiple samples are found to exceed the TCLP limit, the PM will make a determination as to which samples will undergo TCLP analyses. The contract laboratory will be informed by the SMO laboratory coordinator which samples shall be extracted and analyzed using the TCLP provisions outlined in Table 2.

5.8 SAMPLE TRANSPORT

Transport and shipment of samples from the study areas to the contract laboratory will be completed in accordance with PRS procedures PRS-RAD-1105, *Receipt, Transport, and Movement of Radioactive Materials,* and PRS-WSD-9503, *Off-site Sample Shipping*. The following describes key elements of this procedure and other procedures related to sample transport.

Following sample collection, samples will be secured in a cooler containing ice, as necessary. When the cooler has reached capacity, two copies of the completed chain-of-custody form will be placed in a zipper-sealing plastic bag and taped to the inside lid of the cooler. The RCT will perform external radiation surveys of the sample containers to determine if samples can be moved from the site for transport/shipment to the laboratory or if more rigorous sample packing is required. An alpha/beta/gamma scan of each sample container will be performed to support sample packaging/shipping requirements. These Radiation surveys will be completed in accordance with PRS procedure PRS-RAD-1109, *Radioactive Contamination Control and Monitoring*.

PRS personnel will package and label samples, as appropriate, in accordance with U. S. Department of Transportation requirements. Upon completion of radiation surveys, survey forms will be added to the zipper-sealing plastic bag containing the chain-of-custody form, the cooler is resealed in a manner that protects the integrity of the sample, and custody seals will be affixed to the sample cooler to ensure the integrity of sample custody between PGDP and the analytical laboratory.

5.9 WASTE MANAGEMENT

The overall composition and distribution of hazardous, toxic, and/or radioactive materials is not fully known for the rubble areas. To evaluate how IDW will be managed, those materials that contact rubble or associated soils will be stored until radiological screening and field and laboratory data are available to support waste characterization. Any materials contacting contaminated rubble or soil during investigative activities that do not undergo decontamination will be categorized as IDW. The following types of IDW may be generated during the rubble area effort:

- PPE
- Plastic sheeting
- Stainless steel scoops
- Compositing pans
- Direct Push Technology thin-walled sampling tubes
- Miscellaneous sampling and field screening supplies

Segregation, storage, and management of solid IDW and any liquid IDW generated during rubble area sampling efforts will be completed in accordance with the provisions outlined in the PRS Waste Management Plan (WMP), PRS/PROG/0011.

Waste generated during rubble area sampling will be stored in Comprehensive Environmental Resource, Conservation, and Liability Act (CERCLA) waste storage areas at PGDP as approved by PRS waste management and defined in the PRS WMP. This will extend through the period when characterization is ongoing, but prior to disposal.

5.10 HEALTH AND SAFETY

Identified and anticipated hazards associated with rubble area sampling are contained in the Activity Hazard Analysis forms. Details relating to job-specific hazards, as well as the provisions for safeguarding field team members against these hazards, are defined in the site-specific PRS ES&H Plan for rubble area sampling, PRS-CDL-0056. The HSO will oversee the execution and compliance with the PRS ES&H Plan. Implementation of the PRS ES&H plan and overall safe work at the site is the responsibility of each field team member.

Each field team member must have read, fully understand, and have the appropriate level of training relative to site-specific hazards prior to participating in field sampling activities. This will include training related to the following:

- PGDP Environment, Safety, and Health Program;
- PGDP Radiation Protection Program;
- PGDP Integrated Safety Management System elements related to sampling;
- Rubble Areas ES&H Plan, Activity Hazard Analysis, and Radiation Work Permit;
- Rubble Areas specific work packages; and
- Standard Operating Procedures (SOPs) for all field equipment.

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6. ANALYTICAL METHODS

To ensure suitable data are acquired from rubble area field activities, industry standard laboratory methods will be mandated by the laboratory SOW as the basis for fixed laboratory sample analysis. In addition, project-specific detection limits/minimum detectable activities (MDAs)/quantitation limits (QLs) will be provided in the laboratory SOW to ensure analytical sensitivity meets the intended data uses outlined in the DQOs. See Table 2.

The analytical laboratory(s) chosen to conduct analyses will have the appropriate level of qualified personnel, appropriate and properly functioning instrumentation, an approved quality assurance plan, and approved SOPs. The selected laboratory(s) will hold EPA/DOE-CAP certifications to ensure all evaluations can be completed. The contract laboratory will perform sample analysis in accordance with the provisions in this SAP, the laboratory SOW, and the analytical methods specified.

The contract laboratory will be selected from the pre-approved list of PGDP EPA/DOE-CAP approved laboratories based on their ability to meet the technical work scope and cost constraints. The contract laboratory will be selected in accordance with PGDP procedures.

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7. CALIBRATION PROCEDURES

Field equipment and laboratory instrumentation will be calibrated according to both the manufacturer's specifications and the appropriate analytical method specifications. The following sections detail requirements for the maintenance and calibration of laboratory and field instrumentation.

7.1 PREVENTATIVE MAINTENANCE

Preventative maintenance is designed to ensure sample analysis is not delayed by instrument or equipment down time. Contract laboratory and field personnel will perform preventative maintenance for each laboratory instrument and field instrument in accordance with the manufacturer's specifications to ensure they meet the following:

- Are in proper working order during sample analysis;
- Meet sensitivity, precision, and accuracy requirements; and
- Do not cause work stoppages or reporting delays during sample analysis.

7.2 LABORATORY INSTRUMENT CALIBRATION

Laboratory instrumentation will be calibrated and/or tuned in accordance with the specified analytical methods in Table 2. Laboratory instrumentation will be calibrated according to both the manufacturer's specifications and the appropriate analytical method.

Calibrations will be performed for all laboratory instruments prior to their use. The laboratory will comply with all method-specific calibration requirements for requested parameters. If a failure of instrument or equipment is detected, the sample run will be stopped, the instrument will be recalibrated, and all affected samples will be analyzed/reanalyzed using an acceptable calibration. Table 5 summarizes calibration requirements for the analytical methods to be employed by this SAP.

7.3 FIELD EQUIPMENT CALIBRATION/SETUP

The rubble area sampling effort will employ field measurements to direct additional data gathering and any subsequent actions. This will include the performance of field radioactivity measurements, immunoassay field measurements for PCBs, and field XRF spectrometer for field metals analysis.

Daily calibrations of field radioactivity instrumentation, XRF, and the PCB spectrometer are required. In addition, periodic performance checks are required to monitor instrumental drift and/or the need for instrument recalibration. Calibration, operation, and maintenance of each field instrument type will be completed in accordance with the following standard procedures:

- RAD – PRS-RAD-0506, *Radiological Protection Operating Guide*
- RAD – PRS-RAD-1309, *Setup for Operability Tests of Portable Field Instruments*
- PCBs—*HACH Pocket Colormeter™ II Test Kit Instruction Manual*
- XRF—*NITON XLi: 700 Series Environmental Analyzer User's Guide*

Table 5. Calibration Requirements PGDP Rubble Area Samples

Analytical Method:	Required Calibration Elements:
EPA 3540 / 8082	Calibration Curve, Linearity Check, Retention Window Definition, Initial Calibration Check, Continuing Calibration Check
EML HASL 300, 4.5.2.3.	Instrument Calibration, Detector Efficiency, Background Activity Levels, Daily Performance Check (detector & background), Current Control Charts
DOE EML HASL-300, Am-05-RC	Instrument Calibration, Detector Efficiency, Background Activity Levels, Daily Performance Check (detector & background), Current Control Charts
EML HASL 300, 4.5.2.3.	Instrument Calibration, Detector Efficiency, Background Activity Levels, Daily Performance Check (detector & background), Current Control Charts
DOE EML HASL 300	Instrument Calibration, Detector Efficiency, Background Activity Levels, Daily Performance Check (detector & background), Current Control Charts
DOE EML HASL-300, Pu-11-RC	Instrument Calibration, Detector Efficiency, Background Activity Levels, Daily Performance Check (detector & background), Current Control Charts
DOE EML HASL-300, Pu-11-RC	Instrument Calibration, Detector Efficiency, Background Activity Levels, Daily Performance Check (detector & background), Current Control Charts
ASTM D 6480-05	Alignment and systems operation check, camera length calibration, magnification calibration, ultrasonic bath energy deposition, plasma asher calibration
EPA 6010/6020	Calibration Curve, Linearity Check, Retention Window Definition, Initial Calibration Check, Continuing Calibration Check

8. DATA REPORTING, VALIDATION, AND EVALUATION

The following details specific requirements for the reduction of laboratory data, reporting requirements, and procedures to be employed during data validation and evaluation.

8.1 DATA REDUCTION

Data reduction is the process where raw laboratory data is compiled into a coherent report format. Data reduction procedures, whether performed by the instrument or manually following analysis, shall follow the methodologies outlined in laboratory SOPs and/or the analytical method. Project-specific variations to statistical approach or formulas may be identified, depending on project-specific requirements. Further data reduction may be necessary for use at the project level. The laboratory shall adhere to the procedures outlined in each of the analytical methods and the laboratory SOWs. Field personnel performing data acquisition will gather, store, and reduce field measurement data in accordance with the instrument SOP and the provisions of this SAP. The FTL will provide the PRS Data Manager with field measurement data so that it can be loaded into PEMS.

All automated calculations, whether from the instrument, the laboratory information system, or spreadsheets, shall be verified manually before their use. In addition, all software shall be tested with a matching set of sample data to verify its correct operation via accurate capture, processing, manipulation, transfer, recording, and reporting of data.

8.2 LABORATORY QUALITY CONTROL REVIEW

All analytical data generated by the laboratory shall be reviewed and certified prior to release of the report to the SMO. This internal data review process will include reviews of instrumental data and all laboratory data reduction, including internal calculations and data transfers. A minimum of three levels of review will be completed beginning with the analyst, followed by the QA officer, and finally by the laboratory manager or designee.

The analyst who generates the analytical data has the primary responsibility for the correctness and completeness of the data. Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. The application of technical knowledge and experience to the data evaluation is essential in ensuring that data of acceptable quality are generated and reported to the project. All data generated and reduced at the laboratory shall be reviewed and approved in accordance with the analytical procedures and the laboratory SOW, which incorporates the provisions detailed in this SAP.

8.3 LABORATORY REPORTING

Laboratory reports for rubble area sampling will consist of a minimum of Level III data packages, to include all report forms and all supporting raw data, bench sheets, etc. Specifically, data packages will include the following elements in addition to any specific requirements detailed in the laboratory statement of work.

- Sample receiving documentation
- Chain-of-custody forms
- Laboratory sample preparation sheets
- Standard preparation logs
- Table summarizing laboratory and field identification numbers
- Calibration information (report forms and raw data)
- Instrument tuning (report forms and raw data)
- Initial and continuing calibration checks/verifications (report forms and raw data)
- Manual Integration results–if required (raw data)
- Control charts specific to radiochemical parameters (report forms and raw data)
- Blank analysis (report forms and raw data)
- Duplicate sample analysis (report form and raw data)
- Matrix spike (MS)/matrix spike duplicate (MSD) analysis (report form and raw data)
- Post-Digestion Spike Analysis (report form and raw data)
- Laboratory control sample analysis (report form and raw data)
- Tracer recoveries (report form and raw data)
- Surrogate/system monitoring compounds (report form and raw data)
- Internal standard analysis (report form and raw data)
- Inductively coupled plasma interference check samples (report form and raw data)
- Serial dilution sample analysis (report form and raw data)
- Graphite Furnace Atomic Absorption (GFAA) quality control analysis (report form and raw data)
- Linear range analysis (report forms and raw data)
- Inter-comparison QC results for radiochemical parameters (summary forms)
- Activity concentrations plus 1-sigma total propagated uncertainties (with each result)
- Coordinates of grid openings (report form)
- Micrograph number
- X-ray spectrum for each asbestos type and its file and disk number on count sheet
- Length and width for each Asbestos Hazard Emerging Response Act structure.

The laboratory may use its standard report forms when assembling data packages; however, each deliverable must conform to the criteria specified in PRS procedures. The laboratory will perform all calculations in accordance with the analytical methods and standard DOE reporting requirements. In addition, the laboratory will provide summary report forms for all field samples, all laboratory QC indicators, and all raw data necessary to support the reported results.

8.3.1 Content Requirements

To augment the method-specific requirements outlined in this SAP, project-specific reporting requirements also are outlined. They are being provided to ensure that laboratory deliverables provide sufficient information so that complete verification and validation can be completed. The following are key requirements for laboratory data packages, depending on analysis type.

- Sample receiving documentation
- Chain-of-custody forms
- Laboratory sample preparation sheets
- Standard preparation logs
- Table summarizing laboratory and field identification numbers
- Calibration information (report forms and raw data)
- Instrument tuning (report forms and raw data)
- Initial and continuing calibration checks/verifications (report forms and raw data)
- Control charts specific to radiochemical parameters (report forms and raw data)
- Blank analysis (report forms and raw data)
- Duplicate sample analysis (report form and raw data)
- MS/MSD analysis (report form and raw data)
- Laboratory control sample analysis (report form and raw data)
- Tracer recoveries (report form and raw data)
- Surrogate/system monitoring compounds (report form and raw data)
- Internal standard analysis (report form and raw data)
- Interference check samples (report form and raw data)
- Serial dilution sample analysis (report form and raw data)
- GFAA quality control analysis (report form and raw data)
- Linear range analysis (report forms and raw data)
- Inter-comparison QC results for radiochemical parameters (summary forms)
- Radionuclide concentrations, 1-sigma total propagated uncertainties, and MDAs (with each result)

8.3.2 Laboratory Flags

The laboratory shall add laboratory flags during the data generation/review process in accordance with the analytical methods. These are examples of instances when they shall be applied.

- When sample results fall below the reporting limit
- When sample results fall between the reporting limit and the method specified limit
- When a given analyte of concern is found in both the laboratory blank and associated samples
- When samples exceed the upper linear concentration range of the instrument
- When sample results have been diluted and surrogate compounds are not recovered
- When the analyst has rejected a result due to insufficient confirmation
- When the MS is outside of method specified limits
- When method of standard additions is performed
- When method of standard additions fails to produce a curve that is > 0.995
- When the percent difference between GFAA measurements is > 20%
- When GFAA analytical spike recovery falls outside of the 85–115% recovery limits
- When the duplicate or matrix spike duplicate fails to meet the +/- 35% agreement limit
- When at least two of the three specimen grids are not cleared
- When an unacceptable number of grid openings exhibit broken carton replica
- When more that 25% of the grid openings have broken carbon film-over the whole grid opening
- When the specimen grid exhibits approximately 10% obscuration on the majority of grid openings
- When grid loading is not uniform
- When the grid has more that 30 asbestos fibers per grid opening

8.4 LIMITS OF DETECTION

This section describes the procedures to be used for determining limits of detection for samples. In general, these procedures are more fully discussed in the analytical methods. The analytical laboratory will adhere to the procedures herein, as well as those defined in the analytical methods. The limits of detection for field methods are defined by PRS SOPs and the manufacturer's specifications for field test kits and instrumentation referenced in Section 5.1.3.

Several minimum levels of detection for fixed laboratory data are defined in the analytical methods for project sampling activities, including the following:

- Instrument detection limits
- MDLs
- MDA
- QLs

At a minimum, sample data will comply with the detection limits and practical quantitation limits defined in Table 2.

A detection limit is the minimum concentration or baseline of an analytical method. It is defined as the 99% confidence limit of seven consecutive measurements determined on three nonconsecutive days for a low-level reference standard. The laboratory shall establish MDLs for each method, matrix, and analyte for each instrument used for the project. The laboratory shall reestablish MDLs quarterly to account for natural drift and changing instrument conditions and will provide current MDLs as part of each data package. The MDL for each instrument and analysis first is estimated by one of three values:

- The concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5;
- The concentration equivalent of three times the standard deviation of replicate measurement of the analyte in reagent water; or
- The region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).

Seven samples of a matrix spike at the concentration estimated for the MDL then are analyzed. The mean ($\overline{x}$) and standard deviation (s) for each analyte are calculated using the following equations:

$$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Where

$\overline{x}$ = mean

n = number of observations

x_i = i^{th} observation.

$$s = \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n-1}}$$

Where

s	=	standard deviation
n	=	number of observations
x_i	=	i^{th} observation
$\bar{x}$	=	mean of the observations.

Where x_i = the i^{th} measurement of the variable x and $\bar{x}$ = the average value of x.

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

The MDL for each analyte then is calculated using the following equation:

$$MDL = 3.14 \times s$$

NOTE: The one-sided t-statistic 3.14 is at the 99% confidence level appropriate for determining the MDL using seven samples. If the spike level used in step 2 is more than 10 times the calculated MDL, the process must be repeated using a smaller spiking level.

8.5 DATA MANAGEMENT

Data Management for this project will be implemented in accordance with PGDP sitewide management procedures. As part of data management, all laboratory data will be loaded into PEMS. The laboratory will manage copies of all laboratory data generated for the sampling project in accordance with their contract. In addition, internal laboratory records including laboratory logbooks, other internal documentation, corrective action measures, and data packages will be retained by the laboratory until such time as directed by the SMO that the project can be closed out. All electronic deliverables and associated instrument and computer back-ups also will be retained for a period of five years as well to ensure that data can be reproduced, if necessary. The laboratory shall maintain electronic and hardcopy records sufficient to recreate each analytical event conducted pursuant to the laboratory SOW, the analytical method requirements, and this SAP.

8.6 DATA VALIDATION

Upon receipt of laboratory certified data packages, project data will undergo data verification and validation. Verification and validation will be completed in accordance with the following PGDP procedures:

- PA-5107, *Inorganic Data Verification and Validation*; (PRS-ENM-5107, *Inorganic Data Verification and Validation*)

- PRS-ENM-0026, *Wet Chemistry Data Verification and Validation*

- PA-5102, *Radiochemical Data Verification and Validation*; (PRS-ENM-5102, *Radiochemical Data Verification and Validation*)

- PA-5105, *Volatile and Semivolatile Data Verification and Validation*; (PRS-ENM-5105, *Volatile and Semivolatile Data Verification and Validation*)

- ES-B-0811, *Pesticide and PCB Data Verification and Validation* (PRS-ENM-0811, *Pesticide and PCB Data Verification and Validation*)

Fixed laboratory data will undergo data validation to ensure it meets the requirements for use in decision making including human health risk assessment. This will include a minimum of 5% of all project data and will be performed in accordance with site procedures..

8.7 DATA QUALITY ASSESSMENT

The Data Quality Assessment (DQA) will be used to determine whether the collected data meet the project DQOs in accordance with the EPA's DQA guidance documents, *Data Quality Assessment: A Reviewer's Guide* (EPA 2006a) and *Data Quality Assessment: Statistical Methods for Practitioners* (EPA 2006b) and PGDP procedure PA-5003, *Quality Assured Data – Paducah*, (PRS-ENM-5003, *Quality Assured Data*).

8.8 SITE EVALUATION REPORT

The SER will document the findings as a result of implementation of this SAP and include 1) data analysis and an evaluation of any contamination identified, 2) evaluation of the accessibility and potential safety hazards associated with the rubble on DOE property, and 3) documentation of the origin if determined (i.e., did the off-site rubble come from PGDP?).

9. INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

To adequately assess the quality of sampling techniques, the cleanliness of sampling and shipping methods, and laboratory accuracy and precision, QA/QC samples are submitted as blind samples to the laboratory. The following subsections outline specific QC checks that will occur for this project.

9.1 LABORATORY QC PROCEDURES

Laboratory QC procedures will adhere to the analytical methods outlined in Table 2. Key QC procedures, QC samples, and QC sample frequencies are dictated by these methods. In general, the laboratory will analyze two types of QC samples to ensure data quality can be fully verified: (1) instrument quality control and (2) batch quality control.

Instrument QC consists of standard materials used for instrument calibration, periodic instrument calibration checks, and those samples analyzed as part of the analysis process not directly affiliated with natural samples. It is the responsibility of the analyst, the laboratory QA officer, and, ultimately, the Laboratory Manager (LM) to ensure that all instrument QC has been prepared and analyzed properly and that the instruments used to quantify them are operating properly. Any deviations from the requirements outlined in the analytical methods and/or this SAP that affect data quality will be documented by the laboratory and brought to the attention of the PQO or PM immediately before proceeding with analyses. The second form of quality control samples are batch quality control samples. They consist of QC samples prepared and analyzed along with the natural samples or as supplements to natural samples to monitor the effectiveness of the analytical process. Batch quality control includes separate sample analyses and fortified natural samples such as these:

- Preparation or method blanks
- MSs and MSDs
- Laboratory duplicate samples
- Laboratory or method control samples
- Radioactive tracers
- Surrogates/system monitoring compounds
- Internal standards

Laboratory QC samples (e.g., blanks and laboratory control samples) shall be included in the preparation batch with the field samples. An analytical batch is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents. The term analytical batch also extends to cover samples that do not need undergo extraction or digestion. The analytical batch is a group of samples that are analyzed sequentially. The identity of each analytical batch shall be unambiguously reported for each analysis type to ensure reviewers and validators can identify the QC samples and the associated environmental samples. Each analytical method specifies the acceptance limits for batch QC requirements. The laboratory will analyze all batch QC in the same fashion that natural samples are quantified to ensure that realistic data is obtained. At no time may the laboratory alter its preparation or analysis methods to accommodate QC samples.

9.2 FIELD QUALITY CONTROL

Field quality control samples are defined in Section 5.2 of this SAP. Performance of field quality control samples will be evaluated as part of data validation efforts and will generally include the following:

- A review of precision for field duplicates
- A review of accuracy for field standards
- A review of field blank, rinseate, and cross-contamination blank cleanliness
- Effects of blanks on associated field samples

9.3 PERFORMANCE AND SYSTEMS AUDITS AND FREQUENCY

As specified, the contract laboratory must be DOE-CAP compliant in order to perform analyses on rubble area samples. DOE-CAP is the DOE analytical laboratory auditing program where participating laboratories undergo a rigorous review of all procedures annually, record keeping, instrumental maintenance and performance, and reporting. Additionally, participating laboratories undergo quarterly blind audits through the performance evaluation sample program. In order to be considered a qualified laboratory for rubble area sampling, each must submit the previous year's DOE-CAP audit report, resolutions to any findings or concerns, and their latest "acceptable" rating for each of the contaminants identified in this SAP. Failure to provide any of these will result in the laboratory's exclusion from participation on this project.

9.4 CORRECTIVE ACTION

Corrective action procedures are implemented whenever sampling, field monitoring, or laboratory analysis results do not meet the required QA/QC standards. The types of corrective action applicable to environmental analysis are laboratory corrective action(s) and field corrective action(s).

9.4.1 Laboratory Corrective Action

The LM, laboratory PQO, laboratory analysts, and the PRS SMO are responsible for ensuring that all laboratory QA/QC procedures are followed. Situations requiring corrective action and the type of correction required will be as stated in the analytical method or the laboratory SOW. The laboratory will utilize internal QAPs and SOPs to complete all corrective actions identified both internally and externally. Completion of corrective actions will require notification to PRS personnel of any laboratory situation that may impact the usability of the data. If notified of a laboratory nonconformance for which the laboratory seeks the project's required corrective action, sampling and data quality personnel will do the following:

- Notify the PRS PM of the situation;
- Devise a reasonable corrective action in conjunction with the laboratory staff and PRS; and
- Formally request that the laboratory implement the corrective action.

The PQO, PM, and PRS SMO will be responsible for monitoring the effectiveness of all corrective actions. The sampling and data quality personnel will report directly to the PM regarding problems or deviations observed, corrective actions proposed, and the effectiveness of ongoing corrective actions. All laboratory corrective actions will be documented in accordance with the laboratory QA Plan.

9.4.2 Field Corrective Action

The PM and FTL are responsible for ensuring all field sampling procedures are completely followed and that field sampling personnel are adequately trained. The PM and the FTL must document situations that may impair the usability of the samples and/or data in the field logbook. The FTL will note any deviations from the standard procedures for sample collection, chain-of-custody, sample transport, or any other monitoring that occurs. The FTL also will be responsible for coordinating all activities relating to the use of field monitoring equipment (e.g., XRF). This will include any conditions that have resulted in noncompliant measurements taken during field sampling. Ultimately, the PM and the FTL will be responsible for communicating field corrective action procedures, for documenting all deviations from procedures, and for ensuring that immediate corrective actions are implemented in the field.

9.4.3 Notifications for Corrective Actions

In the event field or laboratory activities experience difficulties that will impact project quality and/or schedule, immediate notifications will be made to the DOE project manager and the EPA and KDEP points of contact. Each will be notified when corrective actions have been developed and implemented. Notifications will be made in writing either by e-mail or letter to ensure the corrective action process is properly documented for the Administrative Record.

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10. REFERENCES

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IT Corp (International Technology Corporation) 1989. *Preliminary Radiological Characterization of Ogden Landing Road Concrete Rubble Site*, IT/NS-80-131.

NRC 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, R1, August 2000; DOE/EH-0624, R1; and EPA 402-R-97-016, R1.

PGDP (Paducah Gaseous Diffusion Plant) 1992. *PGDP Environmental Restoration Health Physics Special Purpose/Routine Radiological Survey Results,* Survey No. 92-SP-317-S.

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APPENDIX A

FIELD SAMPLING PLAN AND
QUALITY ASSURANCE PROGRAM PLAN ELEMENTS

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FSP AND QAPP ELEMENTS IN THIS PLAN

Report Section	Description	FSP or QAPP Component
1. Introduction	Summarizes the facility and regulatory basis for the plan	QAPP
1.1 Study Area Background	Summarizes history of the site(s)	FSP
1.1.1 Previous studies	Summarizes previous studies	FSP
1.1.2 WAG 17 RFI	Summarizes WAG 17 RFI study	FSP
1.1.3 Newly identified rubble areas	Describes location and features of new rubble areas	QAPP
1.1.4 Technical justification	Describes reasoning for study	QAPP
2. Project Organization and Responsibilities	Provides an overview of personnel responsibilities	Both
2.1 Project Manager	Describes the responsibilities of the project manager	Both
2.2 Project Quality Assurance Officer	Describes the responsibilities of the project quality assurance officer	Both
2.3 Project Health and Safety Officer	Describes the role of the health and safety officer	FSP
2.4 Field Team Leader	Describes the role of the field team leader	FSP
2.5 Radiological Control Technicians	Describes the role of radiological control technician(s)	FSP
2.6 Sampling Team Members	Describes the role of field samplers	FSP
3. Quality Objectives	Summarizes study objectives	FSP
3.1 Problem Statement	Summarizes why the study is taking place	FSP
3.2 Decision Statements	Describe how the data will be used following the study	FSP
3.3 Decision Inputs	Describes specific objectives to be met by the study, deferred to specific addenda for each study area	FSP
3.4 Study Boundaries	Summarizes where associated study areas are located	FSP
3.5 Decision Rule	Summarizes how project data will be evaluated	FSP
3.6 Decision Error Limits	Describes limitations of available data for SAP preparation in terms of data evaluation	FSP
4. Documentation and Sample Control	Summarizes document and sample handling	FSP
4.1 Documentation	Describes handling of documentation	FSP
4.1.1 Field operations records	Summarizes field documentation	FSP
4.1.2 Laboratory records	Summarizes laboratory document handling	FSP
4.2 Sample Control	Summarizes sample handling and sample numbering	FSP
4.3 Document Control	Summarizes control of all documents	FSP
5. Rubble Survey and Verification Sampling	Summarizes sampling objectives	FSP
5.1. Background	Describes rubble materials	FSP
5.2 Field Quality Control Samples	Summarizes field quality control samples	FSP
5.3 Soil Sampling	Describes materials needed for soil sampling	FSP
5.4 Field Decontamination Procedure for Sampling Equipment	Describes decontamination procedures	FSP
5.5 Sample Handling	Summarizes sampling handling procedures	FSP
5.6 Sample Preservation	Summarizes sample preservation procedures	FSP
5.8 Sample Transport	Summarizes sample transport procedures	FSP

Report Section	Description	FSP or QAPP Component
5.9 Waste Management	Summarizes sample waste management procedures	FSP
5.10 Health and Safety	Summarizes health and safety procedures	FSP
6. Analytical Methods	Summarizes the need for analytical methods and the role of the analytical laboratory	FSP
7. Calibration Procedures	Summarizes the need for calibration requirements	FSP
7.1 Preventative Maintenance	Summarizes preventative maintenance requirements	FSP
7.2 Laboratory Instrument Calibration	Describes instrument calibration requirements	FSP
7.3 Field Equipment Calibration/Setup	Summarizes field calibration requirements	FSP
8. Data Reporting, Validation, and Evaluation	Summarizes reason for validation and evaluation	QAPP
8.1 Data Reduction	Summarizes data reduction techniques	QAPP
8.2 Laboratory Quality Control Review	Summarizes review of laboratory data	QAPP
8.3 Laboratory Reporting	Describes laboratory reporting requirements	QAPP
8.3.1 Content requirements	Describes required contents of data packages	QAPP
8.3.2 Laboratory flags	Describes requirements for laboratory flags	QAPP
8.4 Limits of Detection	Summarizes detection limit requirements, calculation, and use of detection limits	QAPP
8.5 Data Management	Summarizes data management requirements	QAPP
8.6 Data Validation	Summarizes data validation requirements	QAPP
8.7 Data Quality Assessment	Summarizes data assessment requirements	QAPP
8.8 SER	Summarizes site evaluation requirements	QAPP
9. Internal Quality Control Checks and Frequency	Summarizes quality control techniques	QAPP
9.1 Laboratory QC Procedures	Summarizes laboratory QC procedures	QAPP
9.2 Field Quality Control	Summarizes field QC requirements	QAPP
9.3 Performance and Systems Audits and Frequency	Summarizes audit requirements	QAPP
9.4 Corrective Action	Summarizes corrective action requirements	QAPP
9.4.1 Laboratory corrective action	Summarizes laboratory corrective action requirements	QAPP
9.4.2 Field corrective action	Summarizes field corrective action requirements	QAPP
9.4.3 Notification for corrective actions	Summarizes corrective action notification requirements	QAPP

FSP = Field Sampling Plan
QAPP = Quality Assurance Program Plan

APPENDIX B

SUMMARY OF WAG 17 RESULTS

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The WAG 17 Remedial Investigation results identified two AOCs (124 and 127) that posed a potential risk to human health and the environment. AOC 124 since has been remediated through a removal action, and AOC 127 contamination is believed to have originated from a non-DOE source.

AOC/Description	Category[a]	Radiation Screening	Soil/Sediment Sampling	Additional Info.
Bank Control and Erosion Control				
AOC 115 TVA Reservation: Concrete slabs, rubble, steel and conduit pipes used for bank support, channeling and a levee for the "wetlands" slough (approx. 1,000 yd^3).	2	No beta or gamma above background.	PCB soil screening showed no detectable PCBs.	
AOC 116 TVA Reservation: Concrete rubble used in an attempt to halt erosion at a minor tributary run-off ravine entering Bayou Creek (approx. 30 yd^3).	2	No beta or gamma readings for concrete above background; no gamma readings of soil above background.	PCB soil screening showed no detectable PCBs.	
AOC 118 WKWMA: Concrete rubble and slabs used for creek erosion control (approx. 20 yd^3).	1	One slab with beta/gamma activity slightly above background. One spot above AOC reference; biased sample taken; below background.	Three samples collected upstream, one downstream. One plutonium 239/240 at 0.5 pCi/g. Two PCB screening samples showed no detectable levels of PCBs along migratory pathway.	Marked in the field with red paint.
AOC 127 WKWMA: Concrete slabs used for erosion control at a culvert (approx. 10 yd^3).	1	No beta/gamma activity associated with concrete above background; no gamma associated with soils above background levels.	Three biased samples in creek bed; One was above the PGDP background concentration. Analytical sample taken at bias point near culvert: Rad. levels below background; lead 539 mg/kg; PCB screening showed no levels > 0.5 mg/kg.	Metals were detected at elevated concentrations in one sample; attributed to unauthorized dumping of household trash.
AOC 149 BWMA: Concrete slabs and rubble used for erosion control on the face of dam (approx. 15 yd^3).	2	No beta or gamma above background.	PCB soil screening showed no detectable PCBs.	
AOC 151 BWMA: Concrete slabs and rubble used for erosion control on the face of dam (approx. 3,000 yd^3).	2	No beta or gamma above background.	PCB soil screening showed no detectable PCBs.	

AOC/Description	Category[a]	Radiation Screening	Soil/Sediment Sampling	Additional Information
Dam and Structural Support				
AOC 103 South of DOE reservation boundary: concrete, soil, and gravel spoils used to construct a dam and create a fishpond in the WKWMA (approx. 2500 yd^3).	2	No beta/gamma activity associated with concrete above background; no gamma associated with soils above background levels.	PCB soil screening showed no detectable PCBs.	
AOC 104 WKWMA: Concrete spoils used as part of a levee for a fish pond (volume not quantified).	2	No beta/gamma activity associated with concrete above background; no gamma associated with soils above background levels.	PCB soil screening showed no detectable PCBs.	
AOC 112 WKWMA: Concrete slabs, soil and gravel used to build a dam for a fish pond (volume not quantified).	2	No beta or gamma readings on concrete above water above background.	PCB soil screening showed no detectable PCBs.	
AOC 146 BWMA: concrete rubble used in construction of a dam and supporting the dam's face (approx. 2,000 yd^3).	1	Elevated beta activity (12,000 to 70,000 dpm/100 cm^2 measured during screening; no alpha greater than background. Elevated areas smear-tested for transferable contamination – none detected. USRADS® survey found no detectable radiation. Biased survey of spot of historical detection showed no detectable radiation. Alpha scanning showed no radiation above background.	No lab samples collected.	Anecdotal evidence indicates concrete identified during historical radiation survey as having elevated radiation was removed by PGDP.
AOC 147 BWMA: Concrete rubble used for construction of a dam and the dam's face (dam volume approx. 2,000 yd^3; concrete volume indeterminant).	2	No beta or gamma associated with concrete above background.	PCB soil screening showed no detectable PCBs.	

AOC/Description	Category[a]	Radiation Screening	Soil/Sediment Sampling	Additional Information
AOC 150 BWMA: Concrete rubble used to construct a dam and control of erosion on the dam's face (dam volume approx. 3,000 yd^3; concrete volume indeterminant).	2	No beta or gamma associated with concrete above background.	PCB soil screening showed no detectable PCBs.	
Bridge Support and Erosion Control				
AOC 114 TVA Reservation: Concrete rubble used for support and erosion control at a culvert bridge (approx. 40 yd^3).	2	No beta/gamma activity associated with concrete above background; no gamma associated with soils above background levels.	PCB soil screening showed no detectable PCBs.	
AOC 117 TVA Reservation: Concrete rubble used to control erosion around bridge and to support nearby creek bank (approx. 5 yd^3).	1	Beta/gamma screening of the concrete rubble found one piece with a reading of 90 counts per minute above background. USRADS® survey found no widespread elevated radiation. Biased survey done on four spots along creek bank. Mean values below reference and background counts. Three sediment samples taken downstream and one upstream showed plutonium 239/240 (mean of 0.07 pCi/g), technetium-99 (mean 3.5 pCi/g). No concrete collected.	Two PCB screening samples along creek were nondetect.	
AOC 119 WKWMA: Demolished concrete slabs (sidewalks) placed along creek banks, underneath, upstream and downstream of the bridge for erosion control (approx. 5 yd^3).	2	No beta/gamma activity associated with concrete above background; no gamma associated with soils above background levels.	PCB soil screening showed no detectable PCBs.	
AOC 120 DOE Reservation: Concrete slabs, rubble and very large blocks placed under the water line bridge and along the effluent ditch for erosion control (approx. 10 yd^3).	2	No beta/gamma activity associated with concrete above background; no gamma associated with soils above background levels.	PCB soil screening showed detectable PCBs. Analytical results showed PCB results in the parts per billion range.	

AOC/Description	Category[a]	Radiation Screening	Soil/Sediment Sampling	Additional Information
AOC 121 Western edge of DOE reservation: Slabs of concrete rubble used as an abutment of a condemned bridge and a ford that replaced the bridge (approx. 1 yd^3).	1	No radiation levels above background.	Soils analysis showed one metal and three radionuclides detected above background. Sediment samples showed some downstream samples slightly higher than upstream reference sample. PCB screening samples showed no detectable levels of PCBs.	Samples used for radionuclide analysis were the entire amount of material of concern.
AOC 128 DOE Reservation: Concrete slabs, gravel and soil. Slabs used for erosion control on creek banks, underneath, upstream and downstream of the bridge as well as a levee composed of concrete slabs, gravel and soil (minimum of approx. 20 yd^3).	2	No alpha, beta or gamma above background.	PCB soil screening showed no detectable PCBs.	
Roadway Stabilization				
AOC 126 WKWMA: Slabs of concrete on sides of entrance to a gravel pit and roadway (approx. 1 yd^3).	2	No beta/gamma activity associated with concrete above background; no gamma associated with soils above background levels.	PCB soil screening showed no detectable PCBs.	
AOC 148 BWMA: Concrete block, rubble used to stabilize the edge of roadway (approx. 20 yd^3).	2	No beta/gamma activity associated with concrete above background.	PCB soil screening showed no detectable PCBs.	
AOC 197 Private property North of PGDP and WKWMA: 20 to 25 pieces of concrete rubble as roadbed at low-water crossing. Some partially submerged. (approx. 1 yd^3).	2	No alpha, beta or gamma above background on accessible concrete surfaces above the water level.	PCB soil screening showed no detectable PCBs.	

AOC/Description	Category[a]	Radiation Screening	Soil/Sediment Sampling	Additional Information
Isolated Rubble Areas				
AOC 110 Inside DOE reservation: Concrete rubble in areas on sides of road (approx. 200 yd^3).	1	Beta/gamma above background on expansion joint material that was still attached to various slabs of concrete. Avg. reading ~150 counts per minute above background. No radiation in the soil above background.	PCB screenings showed no PCBs migrating from site. No PCB samples taken.	Radiation shine associated with UF_6 cylinder yard.
AOC 111 Inside plant boundaries: Very large pieces of concrete; possible footing material for transmission towers (approx. 1,500 yd^3).	1	13 of 28 grids showed radiation levels that exceeded 3,000 dpm/100 cm^2.	No sediment samples taken. PCB screening showed no detectable PCB results. Surface soils samples along Ogden Landing Road showed total uranium concentration well below reference concentration of 30 pCi/g.	Grids set up on 6m pattern.
AOC 123 WKWMA: Partially paved with concrete from PGDP and uranium hexafluoride tank supports (cylinder saddles) (approx. 500 to 1,000 yd^3).	1	Beta/gamma (200 to 500 counts per minute) above background on isolated areas of the uranium hexafluoride storage tank supports. Four concrete samples take from cylinder supports and collected for leachate analysis. Low levels of some radionuclides present.	No sediment samples collected. PCB screening showed no detectable levels of PCBs in the soil area down gradient of the site.	Marked with red paint.
AOC 124 WKWMA: Sidewalk slabs and other concrete rubble from KOW and PGDP (approx. 20 yd^3).	1	No beta or gamma above background.	Elevated radionuclides found in the soil. DOE performed removal action and soils were sent to waste management area in 1996. No sediments taken. Metals slightly above background. PCB screening downgradient had one positive detect. Analytical PCB sample taken. Results below the action limit and one slightly above the CERCLA action limit for residential land use.	Previous screenings discovered concrete pipe at the surface of AOC with radiation readings of 45,000 counts per minute above background. Pipe was removed.

AOC/Description	Category[a]	Radiation Screening	Soil/Sediment Sampling	Additional Information
AOC 125 WKWMA: Rails, roadbed and crossties, and concrete curbs from KOW and possibly PGDP (approx. 50 yd^3 of railroad spoils and 5 yd^3 of curbing).	1	Discrete rusty spots on concrete with one reading of 2,500 counts per minute and two readings 250 counts per minute above background. USRADS® showed no widespread contamination. Leachate sample showed elevated cessium-137.	No radiation above background in soils. No sediment samples collected. PCBs downgradient – nondetect.	All areas marked with red paint.
AOC 152 BWMA: Concrete rubble, used brick and gravel. Some concrete rubble from PGDP (approx. 50 yd^3).	2	No beta/gamma activity associated with concrete above background.	PCB soil screening showed no detectable PCBs.	
AOC 184 DOE Reservation: Two chunks of concrete from unknown source (approx. 0.2 yd^3).	2	No beta/gamma activity associated with concrete above background.	PCB soil screening showed no detectable PCBs.	

[a] Levels of field screening performed during the WAG 17 investigation
AOC – Area of Concern
BWMA – Ballard Wildlife Management Area
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
PGDP – Paducah Gaseous Diffusion Plant
PCB – polychlorinated biphenyl
TVA – Tennessee Valley Authority
USRADS® – Ultrasonic Ranging and Data System
WKWMA – West Kentucky Wildlife Management Area

APPENDIX C

NEWLY IDENTIFIED RUBBLE AREAS
DESCRIPTIONS AND PHOTOS

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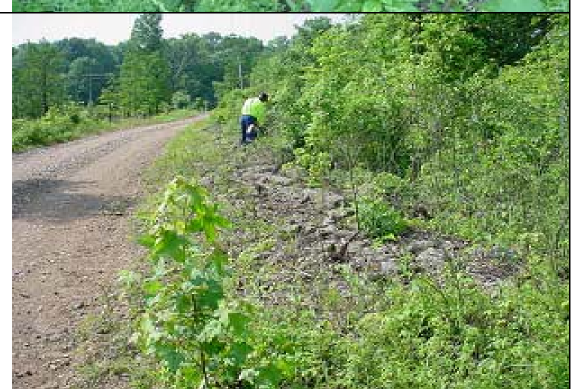
ID#	Property Owner	Composition	Comment	Group	Photos
*KY-15	DOE	Rock & concrete pieces	A 17’ x 8’ x 3’ area consisting of large rocks and concrete pieces used as a bridge barricade	Bridge support	
*KY-16	DOE	Rock & concrete pieces	A 19’ x 17’ x 4’ area consisting of large tires, rock, and concrete pieces used as waterline support as well as rubble on the side of the road	Bank control/erosion control/ drainage	
*KY-17	DOE	Slabs/ concrete pieces	A 40’ x 30’ area consisting of slabs and reinforced concrete pieces used as waterline support and bridge barricade	Bank control/erosion control/ drainage	

ID#	Property Owner	Composition	Comment	Group	Photos
KY-18	DOE	Wooden planks/slabs/ concrete pieces	A 35' x 25' area consisting of wood, wooden planks, railroad ties, concrete pieces from reconstruction of a flume and concrete in the adjacent ditch	Isolated rubble areas	
*KY-19	DOE licensed to WKWMA	Slab/ concrete pieces	A 60' x 30' area consisting of concrete and cinder block slabs and pieces forming a wall used for erosion control, radiological control signs already in place; alpha, beta, gamma, unfiltered 200 counts per minute; fixed contamination; no measurable dose	Bank control/erosion control/ drainage	
*KY-20	DOE	Concrete pieces	A 66' x 11' area consisting of concrete pieces used as the banks of a water treatment lagoon	Dam and structural support	

ID#	Property Owner	Composition	Comment	Group	Photos
*KY-21	DOE	Concrete pieces	A 135' x 8' area consisting of concrete pieces used as the banks of a water treatment lagoon	Dam and structural support	
KY-23	DOE licensed to WKWMA	Concrete and metal pieces in igloo	A 10' x 5' area consisting of a concrete culvert, metal stand or wooden bench and concrete and metal pieces in an igloo	Isolated rubble areas	
KY-24	WKWMA	(8) 55-gallon drums and debris in igloo	Waste in area belongs to a mound of approximately 12' x 8' area and a 1.5' piece of metal. The mound contains (8) 55-gallon drums and debris in an igloo belonging to WKWMA	Isolated rubble areas	
KY-25	WKWMA	Concrete pieces in igloo	A 27' x 20' area consisting of concrete pieces in an igloo, concrete, bricks, cinder blocks and large plastic dishes	Isolated rubble areas	

ID#	Property Owner	Composition	Comment	Group	Photos
KY-26	TVA	7 large pieces of concrete	A 24' x 5' area consisting of 3-4 pieces of concrete near TVA and four large concrete pieces used as road barricades	Isolated rubble areas	
*KY-27	WKWMA	Metal culvert/pipe	A 10' x 8' area consisting of a metal culvert/pipe used as erosion control on the side of the road at a bridge	Bridge support and erosion control	
KY-31	WKWMA	Concrete rubble area	A 7' x 3 area consisting of rubble including two concrete fence bases	Isolated rubble areas	

ID#	Property Owner	Composition	Comment	Group	Photos
KY-33	WKWMA	Concrete culvert	A 25' x 12' area consisting of an abandoned concrete culvert at the site of a new culvert, one piece of metal and miscellaneous concrete rubble	Roadway stabilization/ abandoned culvert	
*KY-34	WKWMA	Large metal culvert	A 30' x 12' x 2' area of concrete on both sides of the road and an abandoned metal culvert at the site of a new culvert	Roadway stabilization/ abandoned culvert	
*KY-36	BWMA	Concrete rubble/cinder blocks	A 300' x 5' area of lake bank consisting of concrete, reinforced concrete, cinder blocks and sheet metal used for erosion control	Bank control/erosion control/ drainage	
KY-38	BWMA	Concrete rubble	A 14' x 5' x 1'area of concrete rubble	Isolated rubble areas	

ID#	Property Owner	Composition	Comment	Group	Photos
KY-39	BWMA	Large concrete slabs	A 10’ x 8’ x 2.5’area of large reinforced concrete slabs	Isolated rubble areas	
*KY-41	BWMA	Concrete rubble	A 150’ x 10’ area of lake bank consisting of concrete, debris and a few plumbing pipes used for erosion control	Bank control/erosion control/ drainage	
*KY-42	BWMA	Concrete rubble	A 25’ x 6’ area of lake bank consisting of concrete, rubble and some twisted metal used for erosion control	Bank control/erosion control/ drainage	

ID#	Property Owner	Composition	Comment	Group	Photos
KY-43	BWMA	Concrete rubble/slabs	A 50’ x 25’ area of concrete rubble and slabs	Isolated rubble areas	
*KY-44	BWMA	Concrete rubble/ drainage tiles	An 80’ x 20’ area drainage ditch consisting of reinforced concrete, with some formed into caps and ceramic pipes as well as concrete rubble and drainage tiles	Bank control/erosion control/ drainage	
*KY-45	BWMA	Concrete rubble slabs	An 8’ x 7’ area ditch bank consisting of concrete rubble slabs	Bank control/erosion control/ drainage	
KY-46	BWMA	Concrete rubble	A 5’ x 10’ area of concrete rubble	Isolated rubble areas	

ID#	Property Owner	Composition	Comment	Group	Photos
*KY-47	BWMA	Concrete rubble/cinder blocks	A 23’ x 12’ area of ditch bank consisting of concrete rubble and broken cinder blocks	Bank control/erosion control/ drainage	
AE	DOE	rubble	A 12’ x 12’ area with two crushed drums, an 11’ visible metal pipe and other piping with multiple piles on the north bank near a clearing	Roadway stabilization/ abandoned culvert	
BH	DOE licensed to WKWMA	Rubble	A 150m x 200m dump consisting of concrete, pipe and debris in mounds north of Outfall 008	Widespread rubble area	
BX	DOE	Rubble	An 8’ x 23’ area of large concrete pieces next to Dyke Road	Roadway stabilization/ abandoned culvert	

ID#	Property Owner	Composition	Comment	Group	Photos
Z	DOE licensed to WKWMA	Rubble	A 38" tall x 3.5' wide dirt-filled clay pipe protruding vertically out from the ground	Isolated rubble areas	

BWMA – Ballard Wildlife Management Area
DOE – Department of Energy
TVA – Tennessee Valley Authority
WKWMA – West Kentucky Wildlife Management Area
*near surface water drainage areas

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